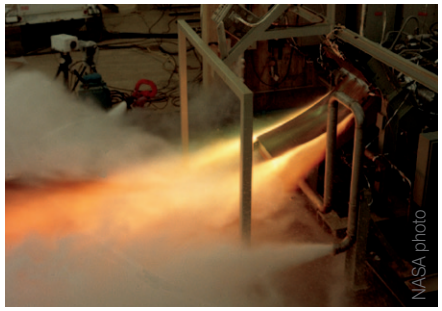
National Aeronautics and Space Administration

U.S. Companies Use NASA Technology to Build Better Rocket Engines

NASA's Balanced Flow Meter helps companies improve engine efficiency


NASA photo


NASA photo

The Balanced Flow Meter (BFM), a patented flow metering technology developed by scientists at NASA's Marshall Space Flight Center, has been used by two U.S. companies to improve the testing, development, and production of safe, reliable, and reusable rocket propulsion systems. The BFM helped a small business better calculate the efficiency of its rocket engines, while a major space and defense contractor used the BFM to achieve accurate and dynamic pulsed flow measurements. By leveraging NASA's technology, these two leading companies in the U.S. commercial space transportation industry have tested and validated their next generation rocket engines and helped to maintain a thriving space program. NASA's technology also is being used by a U.S. chemical company to achieve major cost savings.

Benefits of Technology Transfer

- **Aerospace benefits:** Improves the testing, development, and production of safe, reliable, and efficient rocket propulsion systems.
- **Better accuracy:** NASA's BFM provides 10 times the accuracy of standard orifice-based fluid flow meters, resulting in significant cost-savings to U.S. companies that adopt the technology.
- **Significant lifecycle cost savings:** A U.S. chemical company projects a 3-year lifecycle cost savings of $5.4 million from an initial BFM investment of $5,000.
- **Environmental benefits:** NASA's BFM helps gas and oil refineries reduce their carbon footprint and chemical pollution levels.

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On the Record

"NASA collaborated with two U.S. companies to achieve a superior method of verifying propellant flows and to enable calculations of highly dynamic, pulsed flow systems that were not previously believed possible in a flight configuration." — *Anthony Kelley, Aerospace Engineer, NASA's Marshall Space Flight Center*

"By working closely with our industry partners, we are better able to solve specific technical issues, spinoff new technologies, and this ultimately benefits the nation by creating better space capabilities." — *Anthony Kelley, Aerospace Engineer, NASA's Marshall Space Flight Center*

Technology Origins

Researchers at NASA Marshall originally designed the Balanced Flow Meter for potential use in space shuttle main engines, where a liquid oxygen flow meter enables better system monitoring. The limitations of previous metering technologies necessitated the development of a more accurate and robust metering device. Many other metering technologies are highly intrusive, featuring moving parts that protrude into the fluid, disturbing its flow. These parts can also break, damaging or destroying equipment and making recovery of pressure difficult. NASA's BFM addresses these issues by providing accurate measurements with no moving parts and excellent pressure recovery.

Technology Transfer

NASA's patented technology was licensed in 2003 by A+FlowTek, a small, woman-owned company that has now sold thousands of units in the U.S. and around the world. A+FlowTek is enabling this NASA aerospace technology to find new applications in a wide variety of U.S. industries.

Additional efforts helped two companies in the U.S. commercial aerospace industry also benefit from NASA's BFM. The technology transfer process for these two companies followed distinctly different paths, as described below. Both represent fine examples of how NASA technologies are being leveraged by U.S. companies to enhance their competitiveness in the marketplace.

Commercial Product Benefits Reusable Propulsion Systems

A small business specializing in the rapid development of long-life, reusable rocket engines purchased the BFM through A+FlowTek. As an early adopter of the BFM, this aerospace developer used the technology to measure liquid oxygen and methane in its rocket engine tests. NASA worked on-site with the company's personnel to assist with the BFM's installation and calibration. As a result of this collaboration, NASA was able to fine-tune the BFM's accuracy while the aerospace company was able to independently validate its engine efficiency metrics.

Co-Development Partnership Benefits High-Performance Engines

A major space and defense contractor specializing in missile and space propulsion used the BFM to replace the Coriolis flow meter in its high-performance rocket engine. This rocket engine incorporates an innovative design and combustion chamber, which is packaged within the envelope of existing thrust engines. Use of NASA's BFM in the rocket thruster engine provided, for the first time ever, highly accurate, dynamic pulsed flow measurements of hydrazine and nitrogen tetroxide bipropellant rocket fuels. The partnership with the space contractor was established through NASA's In-Space Propulsion Program, whose mission is to develop primary propulsion technologies that can benefit science missions by reducing cost, mass, and/or travel times. This partnership has helped NASA further develop its BFM and enabled the partner to build rocket engines that are setting new performance records.

Finding a New Use

Aerospace applications like liquid rocket engines and space propulsion—as well as ground testing of these technologies—are not the only areas requiring fluid flow measurements. By replacing standard meters with BFMs, industries such as gas and oil refineries lower costs by improving process accuracy and decreasing pump energy requirements, reducing a company's carbon footprint and chemical pollution levels.

For More Information

If you would like more information about this technology (MFS-31952) or about other technologies available for license, please contact:

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Fuentek is a contractor to NASA's technology transfer program providing support for the access and transfer of technology.